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A Comparative Analysis of mobile Operating Systems

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***Abstract*:** The paper is based on the review of several research studies carried out on different mobile operating systems. A mobile operating system (or mobile OS) is an operating system for phones, tablets, smart watches, or other mobile devices which acts as an interface between users and mobiles. The use of mobile devices in our life is ever increasing. Nowadays everyone is using mobile phones from a lay man to businessmen to fulfill their basic requirements of life. We cannot even imagine our life without mobile phones. Therefore, it becomes very difficult for the mobile industries to provide best features and easy to use interface to its customer. Due to rapid advancement of the technology, the mobile industry is also continuously growing. The paper attempts to give a comparative study of operating systems used in mobile phones on the basis of their features, user interface and many more factors.

Keywords: Mobile Operating system, iOS, Android, Smartphone, Windows.

I. INTRUDUCTION

Mobile operating system is the interface between user and mobile phones to communicate and it provides many more features which is essential to run mobile devices. It manages all the resources to be used in an efficient way and provides a user friendly interface to the users. A mobile operating system (OS) is software that allows Smartphone, tablet PCs and other devices to run applications and programs. A mobile OS typically starts up when a device powers on, presenting a screen with icons or tiles that present information and provide application access. Mobile operating systems also manage cellular and wireless network connectivity, as well as phone access. It has truly become an important part of our everyday life. Talking about its impact, mobile technology affects our life in both ways – positively and negatively. Nowadays its becoming really difficult to choose mobile phones as a wide variety of operating systems are available in the market with various features such as touch screen, cellular, Bluetooth, Wi-Fi, GPS navigation system, camera, speech recognition, voice recorder, music player etc. This paper gives an overview about different mobile operating systems which are most commonly available in the market.

The paper is organized as follows, Section I contains the introduction of the paper which includes basic introduction of mobile operating systems, Section II contains the history of Smartphone, Section III contains the different types of mobile operating systems available with advantages and disadvantages , Section IV describes comparison of various mobile operating systems based on features, Section V concludes research work with future use of mobile technology.

II. HISTORY

The term smart phone was first described by the company Ericsson in 1997. The term was given to the handsets which has difference from other feature handsets. The most significant difference was the advanced "Application Programming Interfaces (APIs)".

The first phone to feature cellular + Personal Digital Assistance (PDA) was developed by IBM in 1992 naming 'simon personal communicator' which could be referred as 'smart phone'. Later in 1996, Nokia released 'Nokia 9000' which has also PDA device with a QWERTY keypad with it. Later then mobile phone operating systems were introduced. Depends upon the operating systems the mobile phones (now a day's Smart phones) are classified [1].

The early Smartphone like IBM's Simon showed us a glimpse of what mobile devices could be. In 2007, their potential was fully realized by Apple and the iPhone. Now, in 2018, they continue to become a staple of our everyday lives.

III. TYPES OF MOBILE OPERATING SYSTEMS

a) **Android:** Google released the first Android OS on September 23th, 2008 by the name of '**Astro**'. After sometime next upgraded versions 'Bender' and 'Cupcake' were also released. Google then adopted the trend of naming

Android versions after any dessert or a sweet in alphabetical order. Just after stepping into the Smartphone and tablets market Android gained immense popularity due to its beautiful appearance and efficient working. Many new features were introduced which played a significant role in Android's success. Google Play is an official app market that contains millions of different apps for Android devices. Samsung HTC, Motorola and many other top manufacturers are using Android in their devices. Currently, Android is one of the top operating systems and is considered serious threat for iPhones. One of the major advantages of Android is the huge developer communities who regularly update and create apps using a customized version of Java. Android OS is updated regularly, each time fixing bugs and adding new features. The latest version is 9.0 (Pie) is released on Aug 6th, 2018. Android App store contains more than 2.6 million applications till Sept 2018.

This technology is based on java

Advantages of Android OS:

- Open Source Platform supported by a wide range of mobile device manufacturer
- Easy access to a lot of free and premium apps that support Android OS
- Multitasking - Android OS is capable of running many applications at the same time
- Easy notification of any SMS, email or RSS reader alert
- The widgetized home screen allows easy access to settings quickly and easily
- The continuous development in looks and features might soon leave other mobile OS far behind in the long run.
- Great for programmers who would like to mess with Linux Kernal for making changes in OS.

Disadvantages of Android OS:

- Very unstable and prone to crashes compared to other Mobile OS
- Being open source, a large number of apps are created by developers. Some of these apps might have bugs which can be exploited by hackers or viral infections. Android's open source makes it more easily accessible to a wide variety of developers but also makes it easier for hackers.
- To log on as administrator for making advanced changes, you need to know Linux commands.
- Continuous updates on the OS might want you to upgrade to the latest which is called rooting. Rooting needs to be done carefully or else you might end up with a piece of brick in hand.
- Most of the Apps require an internet connection for functioning which sometimes is a disadvantage. For e.g. an app for dictionary should have an inbuilt dictionary which allows it to function even when there is no internet connection
- Poor battery backup.

Table 1: Different versions of Android

Code Name	Version Name	Release Date	API Level
Astro	1.0	Sept 23,2008	1
Petit Four	1.1	Feb 9,2009	2
Cupcake	1.5	April 27,2009	3
Donut	1.6	Sept 15,2009	4
Éclair	2.0-2.1	Oct 26,2009	5-7
Froyo	2.2-2.2.3	May 20,2010	8
Gingerbread	2.3-2.3.7	Dec 6,2010	9-10
Honeycomb	3.0-3.2.6	Feb 22,2011	11-13
Ice Cream Sandwich	4.0-4.0.4	Oct 18,2011	14-15
Jelly Bean	4.1-4.3.1	July 9,2012	16-18
Kitkat	4.4-4.4.4	Oct 31,2013	19-20
Lollipop	5.0-5.1.1	Nov 12,2014	21-22
Marshmallow	6.0-6.0.1	Oct 5,2015	23
Nougat	7.0-7.1.2	Aug 22,2016	24-25
Oreo	8.0-8.1	Aug 21,2017	26-27
Pie	9.0	Aug 6,2018	28

b) iOS Mobile Operating System: iOS(formerly named iPhone OS) is from Apple Inc. It has the second largest installed base worldwide on smartphone, but the largest profits, due to aggressive price competition between Android-based manufacturers. It is closed source and proprietary, and is built on the open source Darwin operating system. The iPhone, iPod Touch, iPad and second or

thirdgeneration Apple TV all use iOS, which is derived from macOS[4].

c) iOS is Apple's mobile operating system which was developed for iPhone, but later extended support for iPad and Apple TV. iOS root comes from Mac OS X, hence it is UNIX based OS. iOS was introduced in **29th June 2007** when the first iPhone was developed. Like other OS, iOS is frequently updated starting from iOS version 4.0 and the latest is iOS version 12.1.Apple has still not allowed any other manufacturer to lay hands on its operating system. Unlike Android, Apple has more concentrated on the performance along with appearance. This is the reason that the basic appearance of iOS is almost the same as it was in 2007. Overall it is very user-friendly and is one of the mobile best operating systems in the world so iOS has been used in all iPhones, iPod & iPad.As of March 2018,Apple's App store contains more than 2.1 million iOS applications. The most recent stable release, iOS 12.1, was released on October 30, 2018. It has many features which make it superior choice as compared with others which includes SMS OTP auto fill, multiple faces on face id, detailed battery stats,QR code scanner in Control centre and many more attractive features are available. Various iOS version list includes iPhone OS 1.x (Initial release),iPhone OS 2.x,iPhone OS 3.x,iOS 4.x,iOS 5.x,iOS 6.x,iOS 7.x (major UI revamp),iOS 8.x,iOS 9.x,iOS 10.x (minor UI tweaks),iOS 11.x (minor UI tweaks),iOS 12.x

Advantages of iOS:

- Very stable and secure OS for mobile phones .Apple closely guards their source code.
- Maybe the most loved interface for any mobile OS in the market. Beautifully designed desktop and app icons which go hand to hand with the stunning looks of Apple devices.
- Fewer bugs and secure OS because of high standardization followed when developing apps or updates
- High support for latest web standards
- Good support for cloud storage.
- Easy access to free and premium apps from Apple store

Disadvantages of iOS:

- iOS only support Apple Hardware
- Very costly

d) BlackBerry OS: It is a proprietary mobile OS developed by Canadian company Blackberry Limited, for its BlackBerry line of Smartphone handheld devices. The operating System provides multitasking and supports specialized input devices that have been adopted by Blackberry for use in its handhelds. Blackberry was once the undeniable ruler when it comes to mobile OS. But because of stiff competition from Android and iOS, they lost a considerable share of the mobile market. Blackberry OS also have different versions. A lot of apps developed in the market are compatible with Blackberry OS. BlackBerry OS was discontinued after the release of BlackBerry 10 in January 2013.

e) Symbian OS: Symbian was the most widely used Smartphone operating system in the world until 2010,when it was overtaken by Android .Development of Symbian operating system was discontinued in May 2014.Symbian operating system began as an operating system called EPOC, which was developed in 1980s by a company Psion. In 1998, in a joint venture handset manufacturer Nokia, Ericsson and Motorola, Psion became Symbian OS. In 2008,Nokia acquired Symbian and the majority of source code was released under a open source license. At the time it was one of the largest open source code bases ever released to the public. During 2014,developers was not able to publish new Symbian applications and thus discontinued for the future use.

f) Windows Mobile OS: Windows Mobile is the mobile Operating System developed by Microsoft for mobile devices. This comes with a metro interface and integrates operating system and 3rd part services to work with the device where it is installed. **Windows 10 Mobile** is a mobile operating system developed by Microsoft, released in 2015. Although it is the successor of Windows Phone 8.1, it is an edition of Windows 10 running on devices that have less than a 9-inch screen, as a result of Microsoft's plans to unify Windows families across multiple device classes. Windows 10 Mobile aims to provide greater consistency with its counterpart for personal computers, including more extensive synchronization of content, a new universal application platform that allows one app to run on multiple Windows 10 devices such as PCs, mobile devices and Xbox, as well as the capability, on supported hardware, to connect devices to an external display and use a "PC-like" interface with mouse and keyboard input support. Microsoft has built tools for developers to easily port some iOS apps with minimal modifications. Windows Phone 8.1 Smartphone are eligible for upgrade to Windows 10 Mobile, pursuant to manufacturer and carrier support. Some features vary depending on hardware compatibility. Windows 10 Mobile was designed for use on Smartphone and phablets running on ARM processor architectures. Windows 10 Mobile entered public beta for selected Lumia brand Smartphone on February 12, 2015.The first Lumia Smartphone powered by Windows 10 Mobile were released on November 20, 2015 while eligible Windows Phone devices began receiving updates to Windows 10 Mobile on March 17, 2016, pursuant to manufacturer and carrier support. In October 2017, it was revealed that Microsoft had ceased active development of Windows 10 Mobile due to its low market share and the lack of third-party development for the platform, and that the operating system would only receive bug and security fixes until December 2019.

IV. COMPARISON OF VARIOUS MOBILE OS BASED ON FEATURES

Mobile Devices i.e. handheld devices have become an important part for communication purpose in human being's life. Due to change in technology and time, use of mobile devices shifted towards to Smartphone. In existing work, the authors basically make comparison between Smartphone based operating system like android, iPhone, blackberry and Symbian[3].

Android continues to be the dominant OS in the market. Competition for the second place is between Apple's iOS and Microsoft windows[4].

But if we talk about maintenance it is easier in iOS as it is controlled by Apple. However Android is used in multiple platforms and it is not easy to provide the maintenance on different platforms[5].

Table 2: Different features of various mobile OS

Feature	Android	iOS	Windows 10 Mobile	Black berry 10
Company	Google, Open Handset Alliance	Apple Inc.	Microsoft	BlackBerry Ltd.
Market share	86.2%	13.7%	0.1%	N/A
Current version	9.0	12.0	10.0.15254.490	10.3.3.3216
Current version release dates	Aug 6, 2018	Sept 17, 2018	July 10, 2018	Dec 12, 2016
License	Free and open-source, but usually bundled with proprietary apps drivers	Propri-etary except for open source components	Proprietay, Commercial software	Proprietary
OS family	Linux	Darwin	Microsoft Windows	QNX
Supported CPU architecture	ARM (32-bit ARMv7-A and 64-bit ARMv8-A	64-bit ARMv8-A	32-bit ARMv7-A and 32-bit ARMv8-A	ARM
	only), x86, x86-64[10]			
Programmed in	C,C++,JAVA, kotlin	C,C++, Objective-C, Swift	7+: XNA (.NET C#), Silverlight, native C/C++ (only for vendors and partners[11]) 8+: .NET C#, VB.NET, Silverlight, native C/C++, WinRTP (XMLA), DirectX	C/ C++: Native SDK, C++/Qt: Cascades SDK, HTML5/ Javascript/CSS: Webworks SDK, ActionScript: Adobe AIR, Java: Android runtime
Official App Store	Google Play	App Store	Microsoft Store	BlackBerry World Amazon App Store

V. CONCLUSION

With evolution of mobile phones our life is more connected and it has become almost a basic need in day to day life. It provides the easy communication and sense of security to users. With the availability of powerful mobile operating system and with the tremendous growth in mobile communication technology mobile computing is projected as the future growth area in both academia and industry. There is thus vast scope of potential research and development in this area. The aim of this paper is to review most popular mobile operating system features. We provide a comparison for useful features of mobile OS with advantages and disadvantages that allows mobile users to make a proper choice based upon their need. We have found that android and Windows Phones are superior to others OS. Android is the best Smartphone OS in the world today because of its simplicity. We can also use it as an educational tool. Due to android as an open source operating system, the user can easily install third party applications from markets and even from unreliable sources. Due to this, it has some limitations which lead to malware attacks like virus, worms, spyware, adware and Trojan horse. Another area of research is the issue of power management for mobile phones. Increasing

the battery life without increasing the weight of the phone is a challenging design issue. Therefore necessary steps should be taken to overcome these problems in for future.

The advances of Smartphone continue to grow constantly. It's hard to predict what will come next, but it seems like a throwback to the flip phone (with folding touch screens) is likely. Voice commands are also expected to continue growing.

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Dr. Rina pursued Bachelor of Science from MDU university Rohtak in 2001 and Master of Computer Application from MDU Rohtak in year 2004. After that the author acquired Mphil in year 2006 and completed her Ph.D in Year 2013.She is currently working as Assistant Professor in Department of Information Technology ,GGDSD College, Chandigarh since 2007. She has published more than 08 research papers in reputed international journals. Her main research work focuses on E-commerce, operating system and Data Mining. She has 11 years of teaching experience and 9 years of Research Experience.

